

RAGGED EDGES OF THE SMALL LYMPHOCYTES.¹

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In a rather long differential study of the blood, certain peculiarities of the lymphocytes have been seen to be so constantly present that it has been thought desirable to record a few observations. Several writers have indeed noted the peculiar appearance of ragged edges seen in many of the lymphocyte cells, but beyond this evidently nothing has been done. Jones² speaks of the white corpuscles of the blood as collapsing and "shooting out their walls in processes like the fingers of a glove," but whether he referred to the same appearance mentioned here there is good reason to doubt.

Ehrlich and Lazarus observed that "the contour of the lymphocytes is not quite smooth as a rule, at least in the larger forms, but is somewhat frayed, jagged, and uneven." Cabot, speaking of the same appearance, says, "The edges of the large forms are often frayed and jagged and small bits may bud off and circulate as free elements." Besides these, other writers have observed the irregular outlines as exhibited by the lymphocyte cells.

The observations recorded here have been limited almost entirely to the dried films of the blood. These films have been made on glass slides, the blood being caught on the edge of one slide and immediately spread with the edge of another. The stains generally employed have been those of Jenner and of Wright. The method of staining has been modified frequently to develop the basic more than the acid reaction, in order to give the outlines of cells better definition.

There are to be recognized, in general, two varieties of lymphocytes, commonly known as large and small. The frequent occurrence of intermediate forms, however, makes it difficult to clearly differentiate between the large and small

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² T. W. Jones. *Physiological Pathology of the Blood*. Am. Jour. of Medical Science, July, 1880.

forms. A considerable number of lymphocytes, including all varieties, large, small, and intermediate, in contradistinction to the polymorphonuclear have been seen to possess irregular and ragged outlines. While this is more noticeable in the large forms, it is less constantly present than in the small forms, or, as some have called them, the young lymphocytes, to which variety our attention will be more especially confined.

The small lymphocyte is slightly larger than a red blood corpuscle (8-10 microns) and consists of a large, round nucleus, sometimes showing indentations, surrounded by a thin coat of cytoplasm. The major or nuclear part of the cell usually stains more intensely than the cytoplasm, presents an indistinctly mottled surface, and possesses well-defined borders which may stain either deeply, or faintly, sometimes suggesting a halo. The cytoplasm exhibits more variation in staining and occasionally presents a few granules. It has a much less definite structure and outline than the nucleus.

Both nucleus and cytoplasm suggest a reticulated arrangement of their substance. This is more noticeable in the cytoplasm, and under certain conditions associated with vacuolation becomes especially pronounced. When the eosin or acid stain is gradually increased, the color of this reticulum may change from a deep purple to an intense red. By decolorizing with alcohol various chromatophilic changes can be produced. In a few cells the nuclear reticulum alone takes the acid stain, while in others the entire nucleus takes the blue, and in a few instances the nuclear halo, or better, the nuclear wall, has been seen to stand out very distinctly as a red ring in a pale blue cell.

In a comparatively thick film the small lymphocytes possess very ragged edges whose outlines can be more easily seen when the basic staining has been well developed. A little careful observation will enable one to detect fine processes radiating out from various points along the edges of the cytoplasm. Some extend out for a short distance as minute spines with points hardly perceptible (Fig. 1), while others may be very short, presenting a contracted

appearance (Fig. 2), or exhibiting bud-shaped ends. Occasionally a few lymphocytes can be found which have a crenated appearance (Fig. 3), but in general there is no regularity in the shape of their projections.

In a thinner part of the film the cytoplasm appears to have gathered on one or more sides of the nucleus, distorting the cell into an oval or pear-shaped body (Fig. 4). In such cells the processes are more numerous where the cytoplasm collects. Some of these processes appear to be attached to the slide and some to stretch out to surrounding corpuscles and pieces of débris. Processes from these adjacent cells appear to extend out toward each other in the same line, but it is impossible to trace the continuity which apparently exists, because of the absence of staining properties in such attenuated threads of protoplasm.

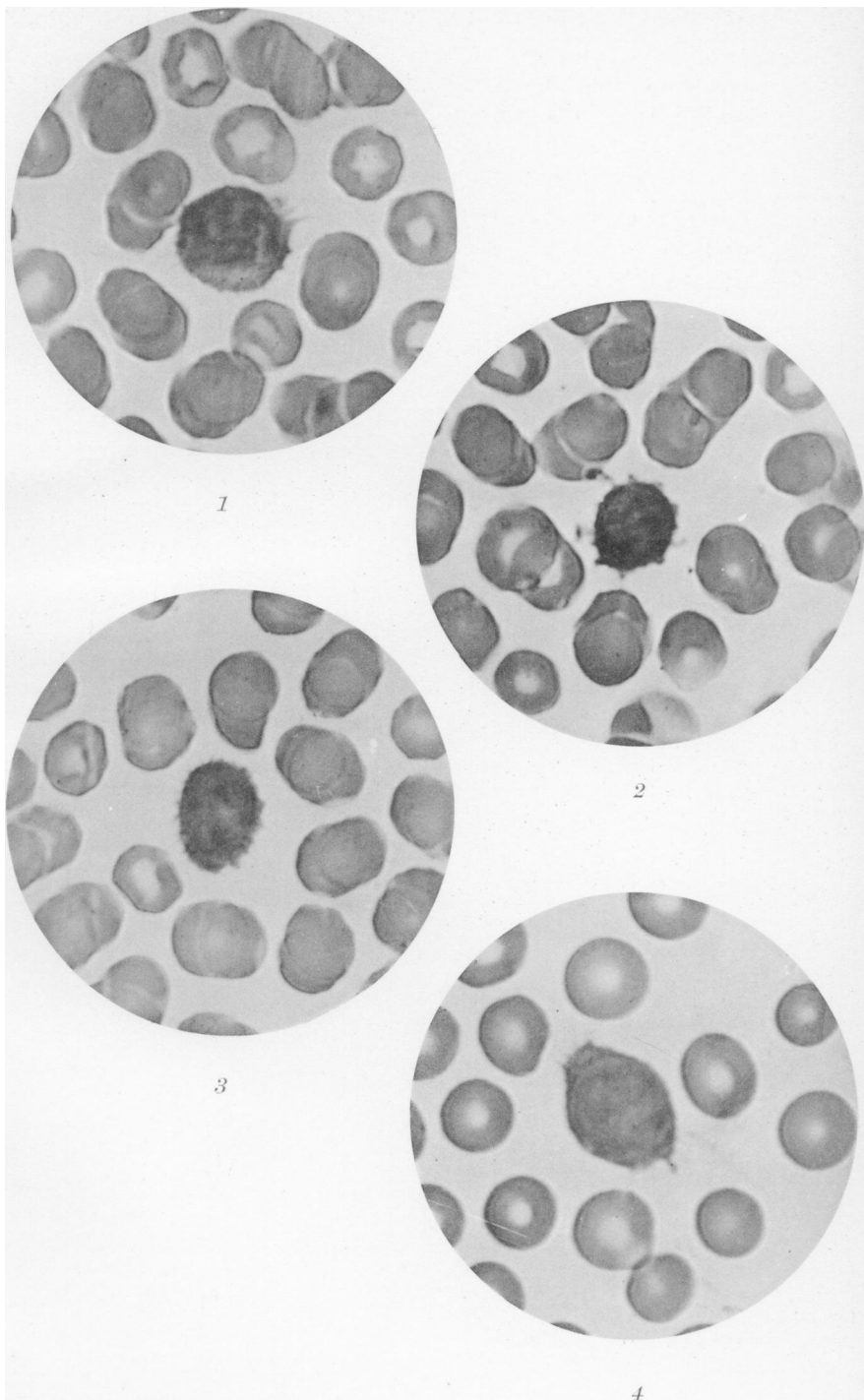
In a few observations made with the warm stage, certain lymphocytes have been seen to be firmly anchored to the surface of the glass, apparently by means of these cytoplasmic prolongations, and in turn the red blood corpuscles were seen attached to the lymphocytes, floating back and forth, tugging at their moorings. When a neutral red solution (neutral red, 5 cubic centimeters sat. sol. normal salt sol., 95 cubic centimeters) is used in connection with the warm stage, all the lymphocytes and often a few of the other white corpuscles exhibit the same irregular fringed edges as seen in the dried film. In this connection might be mentioned the appearance of the platelets, a majority of which are characterized by processes often exceeding in length the diameter of the platelet itself.

Large-sized processes, which one might call typical pseudopods, are sometimes seen on the edges of a few of the lymphocytes and, in contrast to the processes described above, the pseudopods are more numerous where pressure has been applied in making the films. The question naturally arises, whether these processes bear any definite relation to the pseudopods of the other varieties of leucocytes, and whether they are due to the same cause. The pseudopods of the eosinophiles and polymorphonuclear leucocytes differ

somewhat from them, in that they are usually short and broad, while the processes of the small lymphocytes are slender with pointed or bud-shaped ends. In addition, the pseudopods are very rarely found in the stained films, retraction evidently having taken place during the period of drying. At the same time the processes remained extended, and in view of this fact one would hardly be warranted in assuming that these processes are analogous to the pseudopods, either in their formation or special function. They seem rather to have been drawn out than to have been thrust out, and so exhibit in a very interesting way the plastic quality and the adhesive tendency of the cytoplasm.

In explanation of these processes the following possibilities come most prominently into mind: (*a*) that they are the result of retraction produced by the fixing reagents or by pressure in making the films; (*b*) that they are due to the moribund state.

In the dried but unfixed film the processes can be detected, therefore they cannot be due to fixing reagents. If they were due to the moribund state, one would expect them to be more regular and uniform, with an appearance similar to the crenation of the red cells. Instead of that we find them twisted around, stretched out, and at times attached to other cells. Furthermore, in the fresh blood the lymphocytes present the same ragged, indistinct edge seen in the dried and stained films. It is possible that they may play some part in the process of diapedesis and in part account for the large accumulation of the small cells (lymphocytes ?) which takes place in nearly all acute inflammatory conditions.



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Lymphocytes.